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ABSTRACT

This study, carried out in connection with the 1971-72 field test of the "Developing Mathematical Processes" program, was an investigation of relationships among the teacher characteristics, teaching behaviors, and criterion-referenced student performance in mathematics. Students in 15 class samples of size six, along with their teachers, were the participants. Twenty-two significant relationships were identified among the dependent variables (teacher characteristics) and the criterion variables (teaching behaviors). Membership in a multiunit school and the structuring comments of a teacher significantly influenced student level of mastery on a DMP criterion-referenced Topic Invertory in a positive direction; the verbal behavior of a teacher significantly influenced student level of mastery in a negative direction. (MNS)

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Technical Report No. 286

# A STUDY OF MULTIPLE RELATIONSHIPS AMONG TEACHER CHARACTERISTICS, TEACHING BEHAVIORS AND CRITERION-REFERENCED STUDENT PERFORMANCE IN MATHEMATICS

Report from the Project on
Developing Mathematical Processes

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## STATEMENT OF FOCUS

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints--financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

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## ABSTRACT

In 1971-72, the Wisconsin Research and Development Center for Cognitive Learning, hereafter referred to as the Center, began a small scale field test of Developing Mathematical Processes (DMP), the experimental elementary mathematics curriculum materials, which are being produced by the Center. In evaluating the effectiveness of the DMP materials and the related inservice program, the Center collected data on criterion-referenced student performance in mathematics, on teaching behaviors, and on teacher characteristics. The teaching behaviors were defined by the developers as necessary for the successful implementation of the DMP program and are classified as the verbal behaviors of the teachers, structuring the classroom by the teacher, and the structuring comments of the teacher. The teacher characteristics included years of teaching experience, inservice courses, teacher opinion of the DMP program and of school system support of the DMP program.

This study, carried out in connection with the 1971-72 small scale DMP field test, was an investigation of relationships among the teacher characteristics, teaching behaviors, and criterion-referenced student performance in mathematics cited above. The study was further characterized by the following distinguishing features:

1. Curvilinear, as well as linear, relationships were studied by means of multiple regression analysis of data, i.e., a cubic relationship between

years of teaching experience and DMP teaching behaviors was explored and was found to be significantly better or as good as a quadratic relationship in predicting values for teaching behaviors.

2. Efforts were made to stabilize teaching behaviors through teacher participation in a systematic inservice program initiated before the study began and continued during the study.
3. Student achievement in mathematics was assessed three different times during the study by a DMP Topic Inventory which tested the most recent criterion materials the students had an opportunity to learn. In addition, students were tested for maintenance of level of mastery of DMP criterion materials.

Subjects

All children in their first two years of school (approximately 1500) and their teachers (38) in eight schools participated in the field test. Four of the schools were located in central city areas and were organized conventionally into self-contained classrooms in contrast to the second group of four schools, which utilized the multiunit pattern of school organization. One of the multiunit schools was in an urban but non-central city area, while the remaining three schools were in medium-sized cities. The students in fifteen kindergarten classes participating in the small scale DMP field test, who were administered DMP Topic Inventory I, Level 1 (regular and maintained combined), along with their teachers, were the participants in this study.

Statistical Hypotheses

1. Years of teaching experience, inservice course work, teacher opinion of

the DMP program and of school system support of the DMP program do not significantly influence the behavior of a DMP teacher.

2. A teacher's preparation for a DMP activity does not significantly influence the behavior of a DMP teacher.

3. Neither the structuring comments of a teacher, nor the structuring of the classroom by a teacher, nor the verbal behavior of a teacher significantly influences the level of student mastery on Topic Inventory I, Level 1 (regular and maintained combined).

4. Membership in a multiunit school does not significantly influence the level of student mastery on Topic Inventory I, Level 1 (regular and maintained combined).

Results

Twenty-two significant relationships were identified among the dependent variables, teacher characteristics, and the criterion variables, teaching behaviors.

Membership in a multiunit school significantly influenced student level of mastery on a DMP criterion-referenced Topic Inventory (+).

The structuring comments of a teacher significantly influenced student level of mastery on Topic Inventory I, Level 1 (+); the verbal behavior of a teacher significantly influenced student level of mastery on Topic Inventory I, Level 1 (-).

# INTRODUCTION

The Analysis of Mathematics Instruction Project of the Wisconsin Research and Development Center for Cognitive Learning, hereafter referred to as the Center, has undertaken the development of a research-based, elementary mathematics program for grades k-6, Developing Mathematical Processes (DMP) (Romberg and Harvey, 1969; Harvey, Romberg and Fletcher, 1969; Harvey, 1971). DMP is the mathematics component of the Center's program of individually guided education (IGE) designed for particular use in multiunit schools (MUS) (Klausmeier, Quilling, Sorenson, Way and Glassrud, 1971). The Center began a small scale field test, hereafter referred to as a field test, of the DMP program in conventional and multiunit schools in Illinois and Wisconsin during 1971-72 (levels 1 and 2 in grades k and 1). A systematic in-service program has been developed, which assists the field test schools in implementing DMP.

The major characteristics of levels 1 and 2 of the DMP program include an activity approach to learning mathematics, an emphasis on mathematical processes, and an individualized learning system. In keeping with the spirit of an activity approach to learning mathematics, the teaching/learning environment is prescribed in such a way that students are interacting with each other and adults in the room as they solve problems that involve physical materials. Mathematical processes are emphasized by designing the instructional objectives in such a way that students

learn the sequence of steps that are used in solving general types of problems. To support the individualized learning system, DMP includes a criterion-referenced assessment program, which the teacher utilizes to group students and to plan for instruction.

This is a report of a process-product study carried out in connection with the 1971-72 DMP field test, which had the following distinguishing characteristics:

a) This study focused on establishing relationships between teacher characteristics and observable teaching behaviors in DMP classes.

The teacher characteristics included years of teaching experience, inservice courses, degree of teacher support of the DMP program, and teacher opinion of school system support of the DMP program. The teaching behaviors, which are related to an activity approach to learning mathematics, were identified by the developers as needed for the successful implementation of the DMP program. Curvilinear as well as linear relationships were studied, i.e., a cubic relationship between years of teaching experience and DMP teaching behaviors was explored.

Most earlier studies have emphasized linear relationships between teacher characteristics and student achievement. Fattu (1962) and Howsam (1960) reviewed the research on predictor criteria and teacher effectiveness and concluded that, generally, research studies have failed to reveal significant relationships between students' achievement and each of the following: years of teaching experience, collegiate courses or grades, and the professional activity of teachers.

In the area of mathematics, a comprehensive study of teacher characteristics and student achievement was conducted by the Minnesota Laboratory for the Improvement of Secondary Mathematics as part of its effort to evaluate experimental cur-

ricular materials of the School Mathematics Study Group. The findings of the Minnesota study failed ro reveal any significant correlation between students' achievement in mathematics and each of the following: years of teaching experience, preservice courses in mathematics, and the professional activity of teachers (Torrance and Parent, 1966). Further unsuccessful attempts were made in the area of mathematics to relate teacher characteristics to student achievement in the National Longitudinal Study of Mathematical Abilities, a long term study of the effects on students of various kinds of mathematics programs (Travers, 1971).

Therefore, the study differed from earlier studies by setting out to establish that years of teaching experience, inservice courses, degree of teacher support of the DMP program, and teacher opinion of school system support of the DMP program significantly influence teaching behaviors, rather than student achievement. Moreover, this study was not limited to an investigation of linear relationships, as were earlier studies, but included an investigation of curvilinear relationships.

b) This study dealt with establishing relationships between clusters of teaching behavior categories and criterion-referenced student achievement in mathematics.

Process-product studies, which involve several subject areas, have dealt with establishing significant relationships between teaching behaviors and criterion-referenced student achievement (Flanders, 1970; Wright and Nuthall, 1970). In the area of mathematics, the process-product studies reported in the research literature generally utilized standardized tests as criterion measures of student achievement (Perkins, 1965; Soar, 1966). However, one study in the area of mathematics has been reported, which

established relationships between teaching behaviors and criterion-referenced student achievement in geometry (Flanders, 8th grade, 1970).

c) In this study, efforts were made to stabilize teaching behaviors through participation in a systematic inservice program.

Before the study began, teachers attended a DMP workshop which acquainted them with the DMP program and an activity approach to learning mathematics. During the conduct of the study, teachers attended bi-weekly inservice meetings from mid-October to mid-January which emphasized the DMP teaching behaviors and the mathematics content of the DMP program. Earlier process-product studies have not been reported in which efforts were made to stabilize teaching behaviors before a study began and/or during the conduct of the study.

d) In this study, students' achievement in mathematics was assessed three different times, beginning in November, 1971, and continuing to May, 1972, by administering the DMP Topic Inventory, which tested the most recent criterion materials the students had an opportunity to learn.

This assessment procedure of students' achievement in mathematics was unique to this process-product study. Data gathered in this way provided a record of level of student mastery of selected DMP objectives and the rate of instructional progress by school type and level.

In a review of process-product studies, which involve several subject areas and types of curriculum, Rosenshine and Furst (1971) describe the eleven strongest variables contained in this research: clarity, variability, enthusiasm, task-oriented and/or business-like behaviors, student opportunity to learn criterion materials, use

of student ideas and general indirectness, criticism, use of structuring comments, types of questions, probing, and level of difficulty of instruction. The trend of the relationships was positive, with one exception, criticism, which yielded a trend of negative relationships with student achievement. The first five variables yielded the strongest relationships with measures of student achievement.

In the area of mathematics, positive relationships were obtained between students' achievement and each of the following behaviors: use of student ideas (Flanders, 1970; Perkins, 1965), variability (Torrance and Parent, 1966), student opportunity to learn criterion material (Husen, 1967), and level of difficulty of instruction(Husen, 1967; Torrance and Parent, 1966). Negative relationships were obtained between students' achievement in mathematics and criticism (Flanders, 1970; Soar, 1966).

Five of the above variables listed by Rosenshine and Furst are included in this study: clarity, use of student ideas, criticism, use of structuring comments, and probing. The remaining six variables were built into the DMP curriculum materials. The DMP teacher's manual recommends a variety of instructional procedures and materials for each DMP activity; assessment procedures which utilize different types of questions which the teachers can ask students to determine level of mastery of specific objectives; activities which involve different levels of instruction to accommodate student differences. Also the DMP program involves assessment procedures that are criterion-referenced and the DMP activities enable students to learn the criterion materials. In implementing a program which utilizes criterion materials and criterion-referenced topic inventories, the teacher engages in a task-oriented role.

The questions considered in this investigation were:

Question I: Which clusters of categories of classroom teaching behaviors are related to student level of mastery of selected DMP objectives measured by criterion-referenced topic inventories?

McLeod (1972) investigated the effectiveness of the DMP inservice program. The evaluation design included an observation schedule of teacher classroom behaviors. Appendix C contains the Observation Schedule. McLeod reported the proportion of teachers who achieved each objective of the inservice program; that implemented an activity approach to teaching mathematics; and the characteristics of teachers who failed to implement an activity approach in their classrooms. The Center collected data on the level of student mastery of selected DMP objectives measured by criterion-referenced topic inventories as part of their evaluation procedures. A follow-up study was in order which established relationships between the observable teacher classroom behaviors and the level of student mastery of selected DMP objectives.

Question II: Do years of teaching experience, inservice courses, the degree of teacher support of the DMP program, and teacher opinion of school system support of the DMP program influence the behavior of a teacher as she conducts a DMP activity?

The teaching behaviors considered in the study were those determined by the DMP developers as necessary for the successful implementation of DMP classroom activities. The predictors of the criterion variables were predetermined on the basis of informal observations of DMP classes and informal interviews with teachers and principals.

Question III: Does membership in a multiunit school influence a student's level of

mastery of DMP objectives measured by DMP criterion-referenced topic inventories?

The DMP field test includes both conventional and multiunit schools. The multiunit pattern of school organization provides support services for teachers implementing the DMP program, which include teacher aides, planning time, and program coordinators. Generally, the conventional schools provide the same kind of support services but to a lesser degree. The DMP program, when properly implemented, requires more of teachers in terms of planning time and preparation, than most other programs. It was then of interest to determine if membership in a multiunit school was related to student achievement. (See Klausmeier, Quilling, Sorenson, Way, and Glassrud, 1971, for a complete description of the operation of multiunit schools.)

Question IV: Does a teacher's preparation for a DMP activity influence DMP teaching behaviors during the conduct of an activity?

From informal DMP classroom observations, it appeared that prior preparation for an activity influenced a teacher's conduct during an activity, especially whether or not the teacher identified for students the problem and/or objective of an activity.

From the findings of this study multiple relationships can be established among the set of predictors of teaching behaviors, DMP teaching behaviors, and student level of mastery of DMP objectives. Following careful examination of the multiple relationships established, administrators, teachers and DMP program coordinators may be able to refine their decisions relative to which predictors of teaching behaviors and which teaching behaviors should be emphasized, modified, and/or eliminated with the possibility in view of maximizing student level of mastery of DMP objectives.

## THE DESIGN AND CONDUCT OF THE STUDY

### Introduction

This study was carried out in connection with the 1971-72 DMP field test. During the field test, the Center collected data on teacher characteristics, DMP teaching behaviors, and criterion-referenced student performance on DMP Topic Inventories. Students' achievement in mathematics was assessed three different times, beginning in November, 1971, and continuing to May, 1972, by administering the DMP Topic Inventory, which tested the most recent DMP criterion materials the students had an opportunity to learn. In addition, students were tested for maintenance of level of mastery of DMP criterion materials. Over the three testing periods class samples of size six drawn from 3 different kindergarten classes were administered Topic Inventory I, Level 1 to assess level of mastery of DMP criterion materials; class samples of size six drawn from 12 different kindergarten classes were administered Topic Inventory I, Level 1 to assess maintenance of level of mastery of DMP criterion materials. See Table 1 for an account of DMP Topic Inventories which were administered to class samples. Appendix A contains a copy of Topic Inventory I, Level 1. The students in these 15 class samples of size six, along with their teachers, were the participants in this study. The data collected by the Center on teacher characteristics, DMP teaching behaviors and criterion-referenced student performance of these participants was utilized in this study.

TABLE 1

NUMBER OF CLASS SAMPLES OF SIZE 6 SELECTED FROM MUS(1-4) AND CONVENTIONAL SCHOOLS (5-8) ADMINISTERED DMP TOPIC INVENTORIES (T.I.) FOR ASSESSMENT OF LEVEL OF MASTERY OF CRITERION MATERIALS (R) AND FOR MAINTENANCE OF LEVEL OF MASTERY OF CRITERION MATERIALS (M)

| | School | Level 1 | | | | | | Level 2 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | T. I. I | | T. I. II | | T. I. III | | T. I. I | | T. I. II | | T. I. III | | T. I. IV | |
| | | R | M | R | M | R | M | R | M | R | M | R | M | R | M |
| Sample 1 November | 1, MUS | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 2, MUS | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3, MUS | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 4, MUS | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 5, conv. | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 6, conv. | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 7, conv. | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 8, conv. | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Subtotal | $\overline{2}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ |
| Sample 2 February | 1, MUS | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 2, MUS | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| | 3, MUS | - | 2 | - | - | - | - | 2 | - | - | - | - | - | - | - |
| | 4, MUS | - | - | - | - | - | - | 1 | - | 1 | - | - | - | - | - |
| | 5, conv. | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| | 6, conv. | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 7, conv. | - | - | - | - | - | - | - | 1 | 1 | 1 | 1 | - | - | - |
| | 8, conv. | - | 2 | - | - | - | - | - | - | - | - | - | - | - | - |
| | Subtotal | $\overline{1}$ | $\overline{8}$ | $\overline{4}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ | $\overline{3}$ | $\overline{1}$ | $\overline{2}$ | $\overline{1}$ | $\overline{1}$ | $\overline{0}$ | $\overline{0}$ | $\overline{0}$ |
| Sample 3 April | 1, MUS | - | - | - | 2 | 2 | - | - | - | - | - | - | - | - | - |
| | 2, MUS | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | 3, MUS | - | - | - | 2 | 2 | - | - | - | - | 2 | 2 | - | - | - |
| | 4, MUS | - | - | - | - | - | - | - | - | - | 2 | 1 | - | 1 | - |
| | 5, conv. | - | - | - | - | - | - | 2 | - | - | - | - | - | - | - |
| | 6, conv. | - | 2 | 2 | - | - | - | - | - | - | - | 2 | 2 | 2 | - |
| | 7, conv. | - | 2 | 2 | - | - | - | - | - | - | - | - | - | - | - |
| | 8, conv. | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| | Subtotal | $\overline{0}$ | $\overline{4}$ | $\overline{4}$ | $\overline{4}$ | $\overline{4}$ | $\overline{0}$ | $\overline{2}$ | $\overline{0}$ | $\overline{0}$ | $\overline{4}$ | $\overline{5}$ | $\overline{2}$ | $\overline{3}$ | $\overline{0}$ |
| | Total | 3 | 12 | 8 | 4 | 4 | 0 | 5 | 1 | 2 | 5 | 6 | 2 | 3 | 0 |

This study was designed to identify significant relationships, both linear and curvilinear, between teacher characteristics and DMP teaching behaviors; between clusters of DMP teaching behaviors and criterion-referenced student performance on DMP Topic Inventory I, Level 1 (regular and maintained combined); between a teacher's preparation for a DMP activity and DMP teaching behaviors; and between membership in a multiunit school and criterion-referenced student performance on DMP Topic Inventory I, Level 1 (regular and maintained combined). As designed, this study can be classified as a process-product study (Flanders, 1969).

In this study the teacher characteristics included for investigation were years of teaching experience; inservice courses in team-teaching, mathematics, science, and the open classroom; teacher support of DMP; teacher opinion of school system support of DMP. The clusters of DMP teaching behaviors investigated in this study are listed and identified below.

Identification of Clusters of DMP Teaching Behaviors

Cluster I. Structuring Comments--Opening and Closing Activities

Focus--The teacher identifies the problem and/or the objectives of the activity (during the opening or the closing, usually).

Relationship--The teacher states the relationship of this activity to previous work.

Clarity--The teacher explains or summarizes the activity clearly and in a well-organized manner, presenting ideas at a cognitive level appropriate for her students.

Students working--State the ratio of the number of students working profitably on the activity to the number of students not working or confused.

Displays--The teacher displays and discusses student work at the close of the activity as she works for cognitive closure.

Cluster II. Structuring the Classroom (during the middle or main part of the activity)

Grouping--The teacher organizes the students to work on the activity individually, in pairs, in small groups of 3 to 10, or in large groups of 11 or more.

Teacher Movement--The teacher moves from group to group (or individual to individual) in order to act as a resource person for the students.

Student Movement--Students move purposefully about the room to obtain materials, to consult with others, or for other task-oriented reasons.

Student-Student Interaction--Students interact verbally while working on the activity.

Room Arrangement--The teacher arranges furnishings and materials in the room in a way that is appropriate for the activity. (For example, this behavior is demonstrated when the teacher puts several desks together to form a work area for a small group, following suggestions from the description of the activity.)

Assessment--The teacher assesses a student on the objectives of the activity by observation, i.e., the teacher observes a student apparently for purposes of assessment, whether or not the assessment is recorded.

Records Assessment--The teacher records her observations of student achieve-

ment in the pupil performance records.

Re-directs--The reacher re-directs students when they finish an activity.

Cluster III. Verbal Behavior of the Teacher

Use of Student Ideas--The teacher uses student ideas by repeating them, modifying them, applying them, comparing them to other ideas, or by summarizing them.

Probing--The teacher probes a student response, i.e., the teacher asks a student or a group of students to justify or clarify a statement or to validate a mathematical statement.

Criticism--The teacher criticizes a student's contribution to a group discussion or to other group work.

Authority--The teacher acts primarily as a mathematical authority figure rather than asking students to validate or justify their answers.

Statistical Hypotheses

Null-hypothesis I: Years of teaching experience, inservice course work, teacher support of the DMP program, and teacher opinion of school system support of the DMP program do not significantly influence the behavior of a teacher as she conducts a DMP activity.

Null-hypothesis II: A teacher's preparation for a DMP activity does not significantly influence the behavior of a teacher as she conducts a DMP activity.

Null-hypothesis III: Neither the structuring comments of a teacher, nor the struc-

turing of the classroom by a teacher, nor the verbal behavior of a teacher significantly influences the level of student mastery on Topic Inventory I, Level 1 (kindergarten).

Null-hypothesis IV: Membership in a multiunit school is not significantly related to the level of student mastery on Topic Inventory I, Level 1 (kindergarten).

Subjects

All children in their first two years of school (beginning with kindergarten) and their teachers in eight schools participated in the field test; none of the students nor teachers had previously used DMP. Four of the schools were located in central city areas and were organized conventionally into self-contained classrooms in contrast to the second group of four schools, which utilized the multiunit pattern of school organization. One of the multiunit schools was in an urban but non-central city area, while the remaining three schools were in medium-sized cities. The choice of the central city and multiunit schools was made because of the Center's particular interest in determining the program's effectiveness in these settings.

The field test students who were in the 15 class samples of size 6, who were administered Topic Inventory I, Level 1, Form 1 or 2, along with their teachers, were the subjects of this study. Table 2 shows that these 15 class samples were selected from 13 different kindergarten classes in 3 multiunit schools and 4 conventional schools, and were taught the DMP program by 11 different kindergarten teachers.

Forty teachers were included in the field test. During the field test, two first grade teachers left their positions, one from each type of school; this left

TABLE 2

DESCRIPTION OF SCHOOLS, TEACHERS AND STUDENTS PARTICIPATING IN THE FIELD TEST AND IN THIS STUDY

| School | Description | Organization | Field Test | | | | This Study | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | No. of k-teachers | No. of k-classes | No. of 1-teachers | No. of 1-classes | No. of k-teachers | No. of k-classes | No. of samples (size 6) selected from k-classes |
| 1 | medium-sized city | MUS | 1 | 2 | 3 | 3 | 1 | 1 | 2 |
| 2 | medium-sized city | MUS | 1 | 2 | 4 | 4 | 1 | 2 | 2 |
| 3 | medium-sized city | MUS | 2 | 4 | 4 | 4 | 2 | 2 | 2 |
| 4 | urban, non-center | MUS | 2 | 4 | 3 | 3 | 0 | 0 | 0 |
| | | Subtotal | 6 | 12 | 14 | 14 | 4 | 5 | 6 |
| 5 | central city | conventional | 1 | 2 | 2 | 2 | 1 | 2 | 2 |
| 6 | central city | conventional | 2 | 4 | 2 | 2 | 2 | 2 | 3 |
| 7 | central city | conventional | 2 | 3 | 3 | 3 | 2 | 2 | 2 |
| 8 | central city | conventional | 2 | 2 | 4 | 4 | 2 | 2 | 2 |
| | | Subtotal | 7 | 11 | 11 | 11 | 7 | 8 | 9 |
| TOTAL | | | 13 | 23 | 25 | 25 | 11 | 13 | 15 |

38 teachers as participants in the field test. Their mean number of years of teaching experience was 14 with a standard deviation of 9. Table 3 shows that the mean number of years of teaching experience of the kindergarten teachers participating in this study was 12 with a standard deviation of 9.

In Spring, 1971, the participating field test teachers attended meetings at which the DMP program and the field test were described to them, after which they were invited to cooperate in the field test. Each of the participating field test teachers agreed to cooperate in the field test so that their participation was voluntary. A Memorandum of Agreement was discussed with the teachers and subsequently signed by the appropriate administrators.

Instrumentation

Student level of mastery of selected DMP objectives was assessed by DMP criterion-referenced Topic Inventories, Form 1 or 2. Both forms of a DMP Topic Inventory were administered to each sample of size 6; three of each form. See Appendix A for an example of a topic inventory, Topic Inventory I, Level 1 (kindergarten), Forms 1 and 2.

Data on teaching experience, inservice courses, teacher support of the DMP program, and teacher opinion of school system support of the DMP program was collected from teachers using questionnaires. Appendix B contains copies of the questionnaires used.

The mastery of teachers' performance objectives was assessed by an observation schedule, which was piloted in the early stages of the field test and used in the latter stages for assessment. The observation procedures were conducted by two observers

TABLE 3

MEANS AND STANDARD DEVIATIONS OF VARIABLES X(1) TO X(32)

N = 15

| Variable | Mean | Standard Deviation |
|---|---|---|
| X(1) | 11.60 | 8.59 |
| X(2) | 208.40 | 308.68 |
| X(3) | 0.27 | 0.44 |
| X(4) | 0.13 | 0.34 |
| X(5) | 0.47 | 0.50 |
| X(6) | 0.13 | 0.34 |
| X(7) | 2.73 | 0.44 |
| X(8) | 2.73 | 0.70 |
| X(9) | 4984.00 | 10235.79 |
| X(10) | 8.00 | 0.00 |
| X(11) | 7.87 | 0.34 |
| X(12) | 6.40 | 1.96 |
| X(13) | 8.00 | 0.00 |
| X(14) | 6.93 | 1.48 |
| X(15) | 7.53 | 1.31 |
| X(16) | 8.00 | 0.00 |
| X(17) | 8.00 | 0.00 |
| X(18) | 8.00 | 0.00 |
| X(19) | 8.00 | 0.00 |
| X(20) | 7.87 | 0.34 |
| X(21) | 7.87 | 0.50 |
| X(22) | 7.87 | 0.50 |
| X(23) | 7.87 | 0.50 |
| X(24) | 7.67 | 0.87 |
| X(25) | 5.93 | 1.65 |
| X(26) | 7.60 | 1.50 |
| X(27) | 6.53 | 1.59 |
| X(28) | 0.40 | 0.49 |
| X(29) | 1.21 | 0.13 |
| X(30) | 29.20 | 2.76 |
| X(31) | 47.73 | 0.57 |
| X(32) | 27.73 | 4.86 |

trained by the Center, who participated in the conduct of the pilot study and the main study. Both of the observers were experienced teachers of secondary school mathematics, both had Master's degrees, and both were graduate students at the time of the study. Appendix C contains the observation schedule. Inter-observer agreement on a pre-test and post-test was the means chosen to measure the reliability of the observations. The inter-observer agreement on a pre-test was 90.4 per cent and 91.7 per cent on a post-test.

Testing and Monitoring Sequence

In the assessment of the level of student mastery of selected DMP objectives, a stratified random sampling procedure was used that involved the following steps:

1) Three times, beginning in November, 1971, and continuing to May, 1972, classrooms in each grade level were randomly sampled in two strata: urban schools and non-urban schools. (Four visits were planned, but the press of time reduced the actual number of visits to three.)

2) In those selected classes six students and three alternates were randomly selected and data were gathered regarding level of mastery using the topic inventories. An additional six students and three alternates were randomly selected and data were gathered regarding the maintenance of level of mastery using the topic inventories.

In testing the children for level of mastery, monitors employed the following procedures:

1) Determine the students' progress in the instructional sequence.

2) Administer the topic inventory that covers the most recent topic(s) completed.

Then, in testing the children for maintenance of level of mastery, the monitors followed the first procedure listed above and administered the topic inventory that preceded the topic inventory that covered the most recent topic(s) completed. See Table 2 for a summary of topic inventories administered.

In the assessment of teaching behaviors, two observers used an observation schedule to rate each of the teachers in the field test an average of 5 times, with a range of 1 to 8 observations per teacher. The mean number of observations per teacher in this study was 6, with a range from 4 to 8 observations per teacher. During their first three classroom visitations, the observers gathered information on students' reaction to DMP materials, but not on teaching behaviors. The data on teacher performance was obtained after the completion of the DMP inservice program in November. There were four days of observation from November to January scheduled about every two weeks during which data on DMP teaching behaviors was gathered.

Following the recommendations of Medley and Mitzel (1963) and in line with the needs of the study, the observation schedule was developed using a "sign system"--that is, only certain behavior is recorded--as opposed to a "category system," where all behavior is classified into a few mutually exclusive categories. Teaching behaviors related to an activity approach were those included in the observation schedule.

The two observers gathered data on teacher performance in selected schools on a given day. Since up to four teachers at the same grade level taught mathematics at the same time, one observer could not be present for all of each class. Therefore, a time sampling procedure was utilized that would provide information on all of the

DMP teachers. This procedure was preferred over a procedure which involves sampling teachers, because it was desirable to give teachers equal treatment when possible.

A time sampling procedure, which involved the following steps was used:

1) Spend about five minutes in the classroom to become familiar with the DMP activity and other aspects of the context in which the teaching behavior occurs.
2) Observe for five minutes the behavior of the teacher.
3) Record unobtrusively the results of the observation.
4) Repeat the procedure with the next teacher to be observed during that class period. If there is no other teacher to be observed at that time, repeat the procedure with the same teacher.

When there was more than one teacher to be observed during the same class period, the order in which the teachers were observed was determined at random. The observations would start with a different teacher each monitoring day so that each observer would have the opportunity to see each teacher during the opening of at least one activity. Once the cycle was completed and each teacher was observed during the beginning of an activity, a new random order was to be chosen and the observations continued. In order to control for any differences between observers, each observer spent the same amount of time in each school.

# ANALYSIS OF DATA

## Introduction

Multiple regression is a statistical model which is well adapted to the study of problems in education. The model enables one to determine the relationship, linear or curvilinear, between one variable and any number of other variables. The model has been programmed at Southern Illinois University in Carbondale, Illinois, where it is referred to as Program Linear (Kelly, Beggs, McNeil, 1969). In this model, a vector of interest is expressed as a linear combination of appropriately defined vectors, plus an error vector. In this study, the significance of relationships between criterion and predictor variables was determined by means of Program Linear.

The definition of variables included in the investigation of relationships and the procedures of analysis utilized in the investigation of relationships follow. Table 3 shows the means and standard deviations of the variables. The definition of each of the cluster variables is given in terms of teaching behavior variables selected from a related cluster of teaching behavior variables. It was assumed that each of the teaching behavior variables so selected influenced student achievement in the same direction as the related cluster. This assumption was based on informal observations of DMP kindergarten classes.

Definition of Variables

Teacher Characteristics:

X(1), Years of Teaching Experience

X(1) = number of years of teaching experience prior to September, 1971.

$X(2) = X(1)^2$.

X(3), Inservice Courses in Team Teaching

X(3) = 1, if teacher took inservice course(s) in team teaching during past 5 years.

= 0, otherwise.

X(4), Inservice Courses in Mathematics

X(4) = 1, if teacher took inservice course(s) in mathematics during past 5 years.

= 0, otherwise.

X(5), Inservice Courses in Science

X(5) = 1, if teacher took inservice course(s) in science during past 5 years.

= 0, otherwise.

X(6), Inservice Courses in the Open Classroom

X(6) = 1, if teacher took inservice course(s) in the open classroom during past 5 years.

= 0, otherwise.

Note: Rating scale used for X(7) and X(8):

Fully = 3
Moderately = 2
Slightly = 1
Not at all = 0.

X(7), Teacher Support of DMP

X(7) = teacher rating of her support of DMP.

X(8), Teacher Opinion of School System Support of DMP

X(8) = teacher rating of system support of DMP.

$X(9) = X(1)^8$.

Note: The value of each of the variables X(10) through X(27) equals n, where

$a/b = n/8$ and a = number of observations when behavior was achieved

b = a + number of observations when behavior was not achieved

8 = maximum number of observations of any teacher.

X(10), Identification of DMP Materials Required for Success of an Activity

DMP Teaching Behaviors:

Cluster I: Structuring Comments (Opening and Closing).

X(11), Focus

X(12), Relationship

X(13), Clarity

X(14), Students Working

X(15), Displays Student Work

Cluster II: Structuring the Classroom (Main Part of Activity)

X(16), Grouping

X(17), Teacher Movement

X(18), Student Movement

X(19), Student-Student Interaction

X(20), Room Arrangement

X(21), Assessment

X(22), Records Assessment

X(23), Redirects

Cluster III: Verbal Behavior of Teacher

X(24), Use of Student Ideas

X(25), Probing

X(26), Criticism

X(27), Authority

School Membership:

X(28), Membership in Multiunit School

X(28) = 1, if student attends multiunit school

= 0, otherwise.

Student Achievement:

Note: Student mastery of objectives was scored as follows: 1 = mastery
2 = making progress
3 = non-mastery

X(29), Student Level of Mastery, Topic Inventory I, Level 1 (regular and maintained combined)

X(29) = mean mastery score for objectives per sample (size 6) administered Topic Inventory I, Level 1.

Clusters of Teaching Behavior Categories:

X(30), Structuring Comments

$$X(30) = X(11) + X(12) + X(13) + X(14).$$

X(31), Structuring the Classroom

$$X(31) = X(16) + X(17) + X(18) + X(19) + X(20) + X(21).$$

X(32), Verbal Behavior

$$X(32) = X(24) + X(25) + X(26) + X(27).$$

Procedures

First, curvilinear relationships between the dependent variable, years of teaching experience, and the criterion variables, DMP teaching behaviors, were explored. A nine-predictor regression model including predictor variables, X(1) thru X(9), was tested to determine whether it was significantly better than the eight-predictor regression model including predictor variables, X(1) thru X(8), where the cubic term X(9) was deleted. The nine-predictor model was found to be significantly better or as good as the eight-predictor model in predicting values for teaching behaviors and was used to determine significant relationships between the dependent variables and each of the criterion variables. The following procedure was used: X(1), X(2) and X(9) combined were deleted from the nine-predictor model; then X(3), X(4), X(5), X(6), X(7), and X(8) were deleted in succession. By the successive deletion of the predictor variables, the decrease in criterion variance was observed and the significance of relationships determined. Table 4 shows results of the multiple regression analysis.

Next, a three-predictor regression model including predictor variables, X(30) thru X(32), was used to determine significant relationships between the predictor variables, clusters of categories of teaching behaviors, and the criterion

TABLE 4

SUMMARY OF EFFECTS OF PREDICTORS, X(1) THRU X(9), ON TEACHING BEHAVIOR

| Criterion Variables | | Criterion Variance | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | X(1) thru X(9) | X(3) thru X(8) | X(4) thru X(8) | X(5) thru X(8) | X(6) thru X(8) | X(7) thru X(8) | X(8) | Unit model | X(1) thru X(9) | Unit model |
| X(11) | RSQ | .99 | .99*** | .80 | .80 | .79*** | .64 | .56*** | 0 | .99*** | 0 |
| | BETA | --- | -.77 | .62 | .05 | .12 | -.10 | .13 | --- | --- | --- |
| | F-ratio | -1.67 | a | .09 | .31 | 7.92 | 2.86 | 16.51 | --- | 172.52 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(12) | RSQ | .96** | .77 | .76 | .69 | .69 | .63** | .34** | 0 | .96** | 0 |
| | BETA | --- | 8.09 | -10.56 | .59 | 2.19 | -3.69 | 5.37 | --- | --- | --- |
| | F-ratio | 8.88 | .16 | 2.77 | .03 | 2.21 | 9.26 | 6.72 | --- | 14.62 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(14) | RSQ | .85** | .47 | .45 | .43 | .31* | .11 | 0 | 0 | .85* | 0 |
| | BETA | --- | -3.27 | 5.79 | .47 | -2.08 | -.36 | -2.53 | --- | --- | --- |
| | F-ratio | 4.23 | .30 | .30 | 2.10 | 3.18 | 1.52 | .01 | --- | 3.15 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(15) | RSQ | .80* | .33 | .33 | .29 | .17 | .15 | .12 | 0 | .80 | 0 |
| | BETA | --- | -3.17 | 9.83 | -.32 | -.92 | .63 | -4.08 | --- | --- | --- |
| | F-ratio | 3.88 | .04 | .53 | 1.67 | .23 | .52 | 1.70 | --- | 2.21 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(20) | RSQ | .98*** | .52 | .22 | .11 | .10 | .06 | .01 | 0 | .98*** | 0 |
| | BETA | --- | 2.38 | -2.92 | .08 | 1.29 | -1.23 | 1.19 | --- | --- | --- |
| | F-ratio | 30.65 | 4.93 | 1.36 | .02 | .51 | .68 | .11 | --- | 21.85 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(21) | RSQ | .99*** | .66** | .32 | .32 | .28 | .28* | .06 | 0 | .99*** | 0 |
| | BETA | --- | -3.79 | 4.87 | .16 | -1.79 | 1.93 | -1.65 | --- | --- | --- |
| | F-ratio | 597.96 | 8.10 | .00 | .56 | .06 | 3.56 | .90 | --- | 591.93 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(22) | RSQ | .99*** | .66** | .32 | .32 | .28 | .28* | .06 | 0 | .99*** | 0 |
| | BETA | --- | -3.79 | 4.87 | .16 | -1.79 | 1.93 | -1.65 | --- | --- | --- |
| | F-ratio | 597.96 | 8.10 | .00 | .56 | .06 | 3.56 | .90 | --- | 591.93 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(23) | RSQ | .99*** | .66** | .32 | .32 | .28 | .28* | .06 | 0 | .99*** | 0 |
| | BETA | --- | -3.79 | 4.87 | .16 | -1.79 | 1.93 | -1.65 | --- | --- | --- |
| | F-ratio | 597.96 | 8.10 | .00 | .56 | .06 | 3.56 | .90 | --- | 591.93 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(24) | RSQ | .82* | .33 | .32 | .29 | .09 | .09 | .09 | 0 | .82 | 0 |
| | BETA | --- | 8.09 | -13.68 | 2.61 | 5.64 | -3.08 | 4.16 | --- | --- | --- |
| | F-ratio | 4.50 | .03 | .39 | 2.84 | .07 | 1.12 | .02 | --- | 2.49 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(25) | RSQ | .80* | .38 | .35* | .11 | .11 | .11 | .07 | 0 | .80 | 0 |
| | BETA | --- | 9.14 | -16.25 | 2.72 | 6.23 | -4.59 | 3.77 | --- | --- | --- |
| | F-ratio | 3.51 | .47 | 3.23 | .04 | .00 | .48 | 1.02 | --- | 2.24 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(26) | RSQ | .45 | .19 | .18 | .16 | .10 | .09 | .06 | 0 | .45 | 0 |
| | BETA | --- | -4.47 | 8.48 | -.26 | -.79 | .54 | -3.49 | --- | --- | --- |
| | F-ratio | .78 | .02 | .25 | .80 | .12 | .27 | .90 | --- | .45 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | 1,11 | 1,12 | 1,13 | --- | 9,5 | --- |
| X(27) | RSQ | .88* | .45 | .41 | .36 | .25 | .18 | .16 | 0 | .88* | 0 |
| | BETA | --- | 12.85 | -20.92 | 3.46 | 9.66 | -5.23 | 5.45 | --- | --- | --- |
| | F-ratio | 3.93 | .39 | .66 | [illegible] | 1.05 | .27 | 2.49 | --- | 4.04 | --- |
| | df | 3,5 | 1,8 | 1,9 | 1,10 | [illegible] | 1,12 | 1,13 | --- | 9,5 | --- |

Note: RSQ is the criterion variance contributed by the predictor variable(s) indicated. Single, double, and triple asterisks (*) signify the .05, .01 and .001 levels of significance; the criterion variance so marked indicates that the predictor variable(s) deleted from the corresponding regression model significantly influences the criterion variable. The Beta weight of the single predictor variable deleted from the regression model is shown. The F-ratios and degrees of freedom (df) utilized to determine significance are designated. In Program Linear the F-ratio is defined as follows: F = (observed variance of treatment means/$df_1$)/(expected chance variance of these means/$df_2$) where $df_1 = m_1 - m_2$ and $m_1$ = the number of linearly independent vectors in the full model; $m_2$ = the number of linearly independent vectors in the restricted model. $df_2 = N - m_1$ and N = number of subjects in the study (Kelly, Beggs, McNeil, 1969).

a F-ratio exceeds 1000.

variable, student level of mastery of Topic Inventory I, Level 1. The following procedure was used: X(30), X(31) and X(32) were deleted from the three-predictor regression model in succession. Table 5 shows results of the multiple regression analysis.

Finally a one predictor regression model including predictor variable, X(28), was used to determine the significance of relationships between the predictor variable, membership in a multiunit school, and the criterion variable, student level of mastery on Topic Inventory I, Level 1. Table 6 shows the results of the multiple regression analysis. It should be noted that Tables 4 and 5 also summarize the effect of the set of predictors, X(1) thru X(9), on teaching behaviors, and the effect of the set of predictors, X(30) thru X(32), on student achievement.

There was no variance on variable, X(10), Identification of DMP Materials Required for Success of an Activity. Consequently, the relationship between a teacher's preparation for a DMP activity and DMP teaching behaviors was not investigated.

TABLE 5

SUMMARY OF EFFECTS OF CLUSTERS OF TEACHING BEHAVIORS ON STUDENT ACHIEVEMENT
(Topic Inventory I, Level 1, Regular and Maintained Combined)

| Criterion Variable | | Criterion Variance | | | | | |
|---|---|---|---|---|---|---|---|
| | | X(30) thru X(32) | X(31) thru X(33) | X(33) | Unit model | X(30) thru X(32) | Unit model |
| X(29) | RSQ | .44* | .23 | .23* | 0 | .44* | 0 |
| | BETA | -.02 | -.02 | .01 | --- | --- | --- |
| | F-ratio | 4.17 | .01 | 3.96 | --- | 2.93 | --- |
| | df | 1,11 | 1,12 | 1,13 | --- | 3,11 | --- |

Note: RSQ is the criterion variance contributed by the predictor variable(s) indicated. Single, double and triple asterisks (*) signify the .05, .01 and .001 levels of significance; the criterion variance so marked indicates that the predictor variable deleted from the corresponding regression model significantly influences the criterion variable. The Beta weight of the predictor variable deleted from the regression model is shown. The F-ratios and degrees of freedom (df) utilized to determine significance are designated.

Student level of mastery of selected DMP objectives was scored as follows:

1 = mastery
2 = making progress
3 = non-mastery

Therefore, negative Beta weights indicate positive influence of the clusters of teaching behaviors on student mastery of objectives.

TABLE 6

SUMMARY OF EFFECTS OF MULTISCHOOL MEMBERSHIP
ON STUDENT ACHIEVEMENT
(Topic Inventory I, Level 1, Regular and Maintained Combined)

| Criterion Variable | | Criterion Variance | |
|---|---|---|---|
| | | X(28) | Unit model |
| X(29) | RSQ | .18* | 0 |
| | BETA | -.03 | --- |
| | F-ratio | 2.81 | --- |
| | df | 1,13 | --- |

Note: RSQ is the criterion variance contributed by the predictor variable, school membership. The Beta weight of the predictor variable is shown. The F-ratios and degrees of freedom (df) utilized to determine significance are designated. Single, double, and triple asterisks (*) signify the .05, .01, and .001 levels of significance; the criterion variance so marked indicates that the predictor variable significantly influences the criterion variable. Student level of mastery of selected DMP objectives was scored as follows:

1 = mastery
2 = making progress
3 = non-mastery

Therefore, the negative beta weight indicates a positive influence of multischool membership on student achievement.

## RESULTS

1. The set of predictor variables, X(1) thru X(9), significantly predicts each of the following criterion variables: focus, relationship, students working, displays students work, room arrangement, assessment, records assessment, authority.
2. Years of teaching experience significantly influence relationship, students working, displays students work, room arrangement, assessment, records assessment, redirects, use of student ideas, probing, authority.
3. Inservice courses in team teaching significantly influence focus (-), assessment (-), records assessment (-), and redirects (-).
4. Inservice courses in mathematics significantly influence probing (-).
5. Inservice courses in science do not significantly influence any of the teaching behaviors.
6. Inservice courses in the open classroom significantly influence focus (+), students working (-).
7. Teacher opinion of DMP significantly influences relationship (-), assessment (+), records assessment (+), and redirects (+).
8. Teacher opinion of school system support of DMP significantly influences focus (+), relationship (+).

9. Membership in a multiunit school significantly influences student level of mastery on Topic Inventory I, Level 1 (regular and maintained combined)(+).
10. The set of predictors, X(30) thru X(32), significantly predicts student level of mastery on Topic Inventory I, Level 1 (regular and maintained combined)(+).
11. Structuring comments of a teacher significantly influence student level of mastery on Topic Inventory I, Level 1 (regular and maintained combined)(+).
12. Structuring the classroom does not significantly influence student level of mastery on Topic Inventory I, Level 1 (regular and maintained combined).
13. The verbal behavior of a teacher significantly influences student level of mastery on Topic Inventory I, Level 1 (regular and maintained combined)(-).
14. There was no variance on variables X(10), X(13), X(16), X(17), X(18), X(19).

## CONCLUSIONS

Inservice courses had both positive and negative significant influence on teaching behaviors. The kind of courses which significantly influenced DMP teaching behaviors, that belonged to clusters which in turn significantly influenced student level of mastery on Topic Inventory I, Level 1, was of special interest in this study.

Inservice courses in the open classroom had significant positive influence on the behavior, focus; inservice courses in team-teaching had significant negative influence on focus. Focus belongs to the cluster, structuring comments, which in turnhad significant positive influence on student level of mastery on Topic Inventory I, Level 1. Therefore, focus is a behavior which should be emphasized in inservice programs for kindergarten teachers. Consequently, it would be advisable to investigate the inservice courses in team teaching to discover the source of the negative effects on focus, if any, and restructure this type of inservice course, if the results of the investigation indicate it necessary to do so.

Inservice courses in mathematics had significant negative influence on the behavior, probing, that belongs to the cluster, verbal behavior of the teacher, which in turn had significant negative influence on student level of mastery on Topic Inventory I, Level 1. Therefore, a study should be made of this multiple relationship.

The results of this study may indicate that this behavior should be modified by kindergarten teachers and the influence of inservice courses in mathematics on the modified behavior reinvestigated.

Inservice courses in the open classroom had significant negative influence on the behavior, students working, that belongs to the cluster, structuring comments, which in turn had significant positive influence on student level of mastery on Topic Inventory I, level 1. It would then be advisable to investigate the inservice courses in the open classroom to determine the source of the negative effects, if any, and restructure the courses if necessary.

Courses in team teaching had significant negative influence on assessment, which belongs to the cluster, structuring the classroom. Although, this cluster did not significantly influence student level of mastery on Topic Inventory I, Level 1, the behavior, assessment, contributes to effective classroom management routines. Therefore, again it would be advisable to investigate inservice courses in team teaching to identify the source of the negative effects, if any, and restructure the courses if the results of the investigation indicate the necessity to do so.

Teacher support of DMP had significant positive influence on assessment, which belongs to the cluster, structuring the classroom, which in turn had no significant influence on student level of mastery on Topic Inventory I, Level 1. Since the assessment procedures of DMP program are necessary for the smooth articulation of the program through the various levels, teacher support of DMP should be fostered.

The cluster, verbal behavior of a teacher, has significant negative influence on student level of mastery of Topic Inventory I, Level I. Therefore, it is advisable to investigate the behavior categories of the cluster for negative effects on student mastery of DMP objectives; determine the source of the negative effects, if any; and work toward the modification of these behaviors by kindergarten teachers, if the results of the investigation show it necessary to do so. Then a reinvestigation of the influence of the modified behaviors on student level of mastery of DMP objectives would be in order.

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## APPENDIX A

## TOPIC INVENTORY I, LEVEL 1

### Directions

For the Teacher

• Why you should give this inventory

This topic inventory provides you with a formal means of assessing the progress of your students. It supplements classroom observation and will help you assess those children whose mastery of the objectives is doubtful.

• Who should be given this inventory

If there is time--and especially if you have an instructional aide--you should plan to give this inventory to every child in your group. The importance of individual attention cannot be overstated. Even if you know that a child has mastered an objective or needs help, you will both benefit from the time alone together.

This is an individual assessment and requires about ten minutes to administer to each child. If your time is limited it may not be possible for you to formally evaluate all the children. It is important, however, that you do administer the inventory to all children whose progress is in doubt. This includes children who have shown progress toward mastery--P on the observation schedule. It is possible that they have not attained mastery for these objectives and you have now had a chance to observe the new behavior. You should also give this topic inventory to those children who have

needed considerable help (N) in the past, but who have not been reevaluated recently by observation.

• What to do with the results of this inventory

After administering this inventory you will be able to tell which objectives the children have mastered and which are causing difficulty. You can use this information to regroup the children and decide which activities are most appropriate for them.

Children who still need considerable help with the objectives in the topics covered by this inventory should be grouped separately. Give them additional activities from these topics before they go on to the ones that follow. You may assess progress during the additional activities by using the observation schedules outlined in the teacher's guide. After review if progress is still in question, or if any children have N or P ratings on objectives, administer Form 2 of this inventory.

Children who have demonstrated mastery of the objectives covered by this inventory may go on to the next topic. Those who are making progress toward mastery may also go on, but they should be helped if they have difficulty with the new material. They should also be given a review of the objectives from the topics covered by this inventory. You may accomplish this by tutoring each student for a few minutes during the individual activities of the new topic. To encourage peer teaching you may choose to have the whole group do an activity for review. It may be convenient to occasionally group children who have made progress with those who need considerable help since they will both be reviewing.

Task 6 is a preliminary assessment of several objectives in Topic 1.2. It will help you identify those children who are already acquainted with length and its

terminology. In the following activities you may wish to group these children with children who need help. If most children are able to respond as desired you may want to omit some activities in Topic 1.2 for most or all of the children in your group.

For the Person Who Gives the Inventory

You are urged to go through this inventory once or twice before giving it to any of the children.

Each task in this assessment is directly related to at least one objective. The objective is listed directly below the statement of the task. As you go through the topic inventory with a child, record your judgments about his performance. Write his rating beside the appropriate objective number on the Individual Progress Sheet or Topic Checklist. The assessment criteria are:

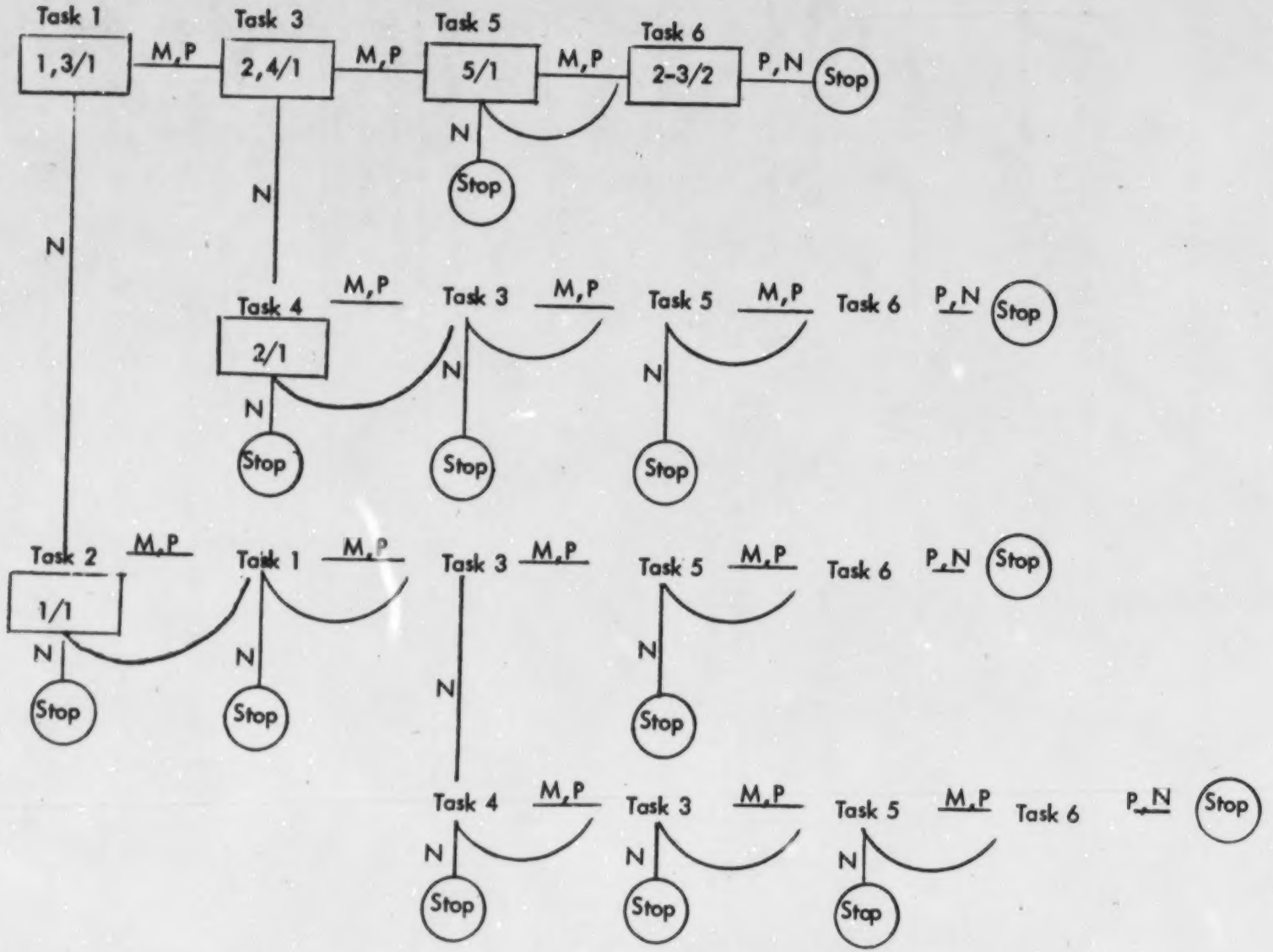
| | | |
|---|---|---|
| M | Mastery | You are convinced by the child's performance of the assessment task that, given a similar task, he could exhibit the required behavior. This category includes children who immediately respond as desired on their own or respond correctly after you have reworded the task question. To qualify for mastery, where a task question has two parts, the child must respond as desired to both parts. |
| P | Making Progress | The child's response to the task indicates that he has not fully mastered the objectives. This category includes children who respond as desired after a |

| | | |
|---|---|---|
| | | little hinting or prompting from you. In cases where a task question has two parts, the child must respond as desired to both parts. |
| N | Needs considerable Help | The child is unable to respond to the task by himself and needs many hints from you before responding correctly; or he responds inaccurately or in a random fashion, indicating he does not understand what is required. |

## Description

The flow chart that follows this introduction and the rating section in each task will help you plan which tasks you should administer to each child. The hints accompanying each task are suggestions for prompting the child if he does not show mastery of the objective immediately. It is suggested that you first reword the question for the child. If he fails to respond as desired, you should give him several small hints. If he is still unable to respond show him how to complete the task. You may then discontinue giving the inventory, providing the child with review work, or you may have the child continue on to the next task.

To shorten the time required for this assessment, two tasks have been designed to measure four objectives. If the child is successful with Tasks 1 and 3 you may indicate that he has mastered all four objectives without actually administering Tasks 2 and 4.


Task 1
1,3/1
M,P
Task 3
2,4/1
M,P
Task 5
5/1
M,P
Task 6
2-3/2
P,N
Stop
N
Stop
N
N
Task 4
2/1
M,P
Task 3
M,P
Task 5
M,P
Task 6
P,N
Stop
N
N
Stop
Stop
Stop
Task 2
1/1
M,P
Task 1
M,P
Task 3
M,P
Task 5
M,P
Task 6
P,N
Stop
N
N
N
N
Stop
Stop
Stop
Task 4
M,P
Task 3
M,P
Task 5
M,P
Task 6
P,N
Stop
N
N
N
Stop
Stop
Stop

## Form 1, Task 1

TASK: stating likenesses and differences between two objects in terms of their attributes

OBJECTIVES: Topic 1: 1 and 3

MATERIALS: 2 objects--such as a baseball and a large kickball or tether ball--that are similar in at least two ways and different in at least two other ways

FIRST PART: Likenesses

| DO | SAY |
|---|---|
| Give the child the two objects. | Tell me two ways these things are alike. |

Response desired: The child names two similarities between the objects. In the case of the balls, he may name shape, color, or materials.

SECOND PART: Differences

| DO | SAY |
|---|---|
| Point to the objects. | Tell me two ways these things are different. |

Response desired: The child names two differences between the objects. In the case of the balls, he may name size, color, different stitching, or design.

HINTS

If the child is trying Task 1 for the first time and

hesitates in responding to either part, go immediately to Task 2, page 41, without giving a rating for this task.

hesitates in responding, ask him to look for the things that are the same (different) for the objects.

is still unsure, point out one similarity (difference) and ask him if they are alike (different) in other ways.

does not respond as desired, show him the similarities (differences).

ASSESSMENT

Record the rating as described in the directions on p. 34.

If the rating is

M, go to Task 3. (See note below.)

P, go to Task 3. (See note below.)

N, stop or go to Task 3.

Note: Recall that for an M or P rating, a child must complete both parts of this task successfully.

## Form 1, Task 2

TASK: describing an object in terms of its attributes

OBJECTIVE: Topic 1: 1

MATERIALS: an object, such as a white baseball

| DO | SAY |
|---|---|
| Give the child the ball. | Tell me three things about the ball. |

Response desired: The child says the ball is white, round, small, soft, smooth, has stitching, etc. He mentions at least three attributes.

HINTS

If the child

hesitates, ask him what color or what shape the ball is.

cannot name three attributes of the ball, point out some attributes to him.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 1.

P, go to Task 1.

N, stop or go to Task 1. (See note below.)

Note: The behaviors required in Tasks 1 and 2 are prerequisite or similar to behaviors in the rest of this topic inventory. If the child has trouble answering these task questions, he probably cannot answer further questions. Therefore, we advise you to stop and give this topic inventory or its equivalent form to the child at a later date when he has reviewed these objectives through additional activities. However, you may continue this inventory now if you desire further information about the child's progress.

## Form 1, Task 3

TASK: sorting objects into sets on the basis of a given attribute

OBJECTIVES: Topic 1: 2 and 4

MATERIALS: the 8 Clown Cards

| DO | SAY |
|---|---|
| Give the child the Clown Cards. | Sort the clowns according to size. Put together all the clowns that are the same size. |

Response desired: The child sorts the cards, putting together all the clowns of the same size.

HINTS

If the child is trying Task 3 for the first time and

hesitates, go immediately to Task 4, page 43, without giving a rating for this task.

If the child is repeating Task 3 and

hesitates, ask him to put the fat clowns together in one set and the thin clowns together in another set.

is still unsure, start to do the sorting, and ask him to finish it.

does not respond at all or responds incorrectly, do the sorting for him, pointing out the size of each clown.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 5.

P, go to Task 5.

N, stop ot go to Task 5.

## Form 1, Task 4

TASK: choosing an object possessing a given attribute

OBJECTIVE: Topic 1: 2

MATERIALS: 4 Clown Cards: 2 spotted ones and 2 striped ones.

| DO | SAY |
|---|---|
| Give the child the Clown Cards. | Show me the clowns with stripes. |
| Response desired: The child points to or holds up one or both Clown Cards. | |

HINTS

If the child

hesitates, ask him to look at the cards carefully.

still does not respond, hold up one of the striped Clown Cards and point out the stripes. Then ask him to show you another striped clown.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 3.

P, go to Task 3.

N, stop or go to Task 3.

## Form 1, Task 5

TASK: stating an attribute common to all the members of a set

OBJECTIVE: Topic 1: 5

MATERIALS: the 8 Clown Cards

| DO | SAY |
|---|---|
| Sort the Clown Cards by expression (smiling and frowning) and place both sets in front of the child. Point to one of the sets. | What do all these clowns share that is different from the clowns in the other set? |
| Response desired: The child says that the clowns are all happy or smiling (sad or not smiling or frowning). | |

HINTS

If the child

hesitates, tell him to look carefully at all the cards in one of the sets and tell you how they look alike.

is still unsure, show him the common attribute for that set (smiling or frowning) and ask him to tell you how the clowns in the other set are alike.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 6.

P, go to Task 6.

N, stop or go to Task 6.

## Form 1, Task 6

TASK: comparing and ordering two objects on length

OBJECTIVES: Topic 2: 2 and 3

MATERIALS: 2 crayons of unequal lengths

| DO | SAY |
|---|---|
| Give the child the crayons. | Give me the shorter crayon. |
| Response desired: The child hands you the shorter crayon. | |

HINTS

If the child

hesitates, show him how to compare the crayons by matching them one-to-one with the ends lined up and ask him to give you the shorter crayon.

is still unsure, show him the shorter crayon. Tell him that he will be learning about length in the next math lessons and that this task will soon be easy for him.

ASSESSMENT

Record the rating as described in the directions on page 34 and stop.

## Form 2, Task 1

TASK: stating likenesses or differences between two objects in terms of their attributes

OBJECTIVES: Topic 1: 1 and 3

MATERIALS: 2 objects, such as a pencil and a pen that are similar in at least two ways and different in at least two other ways

FIRST PART: Likenesses

| DO | SAY |
|---|---|
| Give the child the two objects. | Tell me two ways these things are alike. |

Response desired: The child names two similarities between the objects. In the case of the pencil and pen, he may name shape, use in writing, point on one end, length, etc.

SECOND PART: Differences

| DO | SAY |
|---|---|
| Point to the objects. | Tell me two ways the things are different. |

Response desired: The child names two differences between the objects. In the case of the pencil and pen, he may name length, color, material, etc.

HINTS

If the child is trying Task 1 for the first time and

hesitates in responding to either part, go immediately to Task 2, page 48, without giving a rating for this task.

If the child is repeating Task 1 and

hesitates in responding, ask him to look for the things that are the same (different) for the objects.

is still unsure, point out one similarity (difference) and ask him if they are alike (different) in other ways.

does not respond as desired, show him the similarities (differences).

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 3. (See note below.)

P, go to Task 3. (See note below.)

N, stop or go to Task 3.

Note: Recall that for an M or P rating, a child must complete both parts successfully.

## Form 2, Task 2

TASK: describing an object in terms of its attributes

OBJECTIVE: Topic 1: 1

MATERIALS: an object, such as a ruler

| DO | SAY |
|---|---|
| Give the child the ruler. | Tell me three things about the ruler. |

Response desired: The child says the ruler is long, flat, wood, straight, has marks, etc. He mentions at least three attributes.

HINTS

If the child

hesitates, ask him what color the ruler is or what shape it is.

cannot name three attributes of the ruler, point out some attributes to him.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 1.

P, go to Task 1.

N, stop or go to Task 1. (See note below.)

Note: The behaviors required in Tasks 1 and 2 are prerequisite or similar to behaviors in the rest of this topic inventory. If the child has trouble answering these task questions, he probably won't be able to answer further questions. Therefore, we advise you to stop and give this topic inventory or its equivalent form to the child at a later date when he has reviewed these objectives through additional activities. However, you may continue this inventory now if you desire further information about the child's progress.

## Form 2, Task 3

TASK: sorting objects into sets on the basis of a given attribute

OBJECTIVES: Topic 1: 2 and 4

MATERIALS: the 8 Face Cards

| DO | SAY |
|---|---|
| Give the child the Face Cards. | Sort the faces according to size. Put all the faces that are the same size together. |

Response desired: The child sorts the cards, putting all the faces of the same size together.

HINTS

If the child is trying Task 3 for the first time and

hesitates, go immediately to Task 4, page 50, without giving a rating for this task.

If the child is repeating Task 3 and

hesitates, ask him to put the fat faces together in one set and skinny faces together in another set.

is still unsure, start to do the sorting, and ask him to finish it.

does not respond at all or responds incorrectly, do the sorting for him, pointing out the size of each face.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 5.

P, go to Task 5.

N, stop or go to Task 5.

## Form 2, Task 4

TASK: choosing an object possessing a given attribute

OBJECTIVE: Topic 1: 2

MATERIALS : 4 Face Cards, two with ears and two without ears

| DO | SAY |
|---|---|
| Give the child the Face Cards. | Show me the faces with ears. |
| Response desired: The child points to or holds up one or both Face Cards with ears. | |

HINTS

If the child

hesitates, ask him to look at the cards carefully.

still does not respond, hold up one of the Face Cards with ears and point out the ears. Then ask him to show you another face with ears.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 3.

P, go to Task 3.

N, stop or go to Task 3.

## Form 2, Task 5

TASK: stating an attribute common to all the members of a set

OBJECTIVE: Topic 1: 5

MATERIALS: the 8 Face Cards

| DO | SAY |
|---|---|
| Sort the Face Cards by expression (smiling and frowning) and place both sets in front of the child. Point to one of the sets. | What do these faces share that is different from the faces in the other set? |

Response desired: The child says that the faces are all happy or smiling (sad or not smiling or frowning).

HINTS

If the child

hesitates, tell him to look carefully at all the cards in the set and tell you how they look alike.

is still unsure, show him the common attribute for that set (smiling or frowning) and ask him to tell you how the faces in the other set are alike.

ASSESSMENT

Record the rating as described in the directions on page 34.

If the rating is

M, go to Task 6.

P, go to Task 6.

N, stop or go to Task 6.

## Form 2, Task 6

TASK: comparing and ordering two objects on length

OBJECTIVES: Topic 2: 2 and 3

MATERIALS: 2 pencils of unequal lengths

| DO | SAY |
|---|---|
| Give the child the pencils. | Give me the longer pencil. |
| Response desired: The child hands you the longer pencil. | |

HINTS

If the child

hesitates, show him how to compare the pencils by matching them one-to-one with the ends lined up and ask him to give you the longer pencil.

is still unsure, show him the longer pencil. Tell him that he will be learning about length in the next math lessons and that this task will soon be easy for him to do.

ASSESSMENT

Record the rating as described in the directions on page 34, and stop.

## APPENDIX B

## QUESTIONNAIRE I

The report of the DMP Field Test that you will receive will give a general description of the participating teachers and students. The purpose of this questionnaire is to gather this general background information on teachers. Of course, this information will be reported only in terms of group data, such as average age, not as individual responses.

1. Please state the degrees you hold, the year when each degree was received, and the institution that granted the degree.

| Degree | Year | Institution |
|---|---|---|

2. Describe briefly any educational training that you have had in the past five years that is related to the topics listed below. Please include in your description the length of the training period and the name of the sponsoring institution.

   a. Elementary Mathematics

   b. Elementary Science

c. Individualizing Instruction

d. The "Open Classroom" or the British Infant Schools

e. Team Teaching

3. How many years of teaching experience do you have, including this year?

4. Please outline your teaching experience of the past five years.

| School System | Grade Level | Dates |
|---|---|---|
| | | |

5. Have you been involved in the development and tryout of any other curriculum programs besides DMP?

If yes, please give details.

6. Aside from your teaching, what other educational experience (if any) have you had in the past five years?

7. What is your age?

20-24 _____ 25-29 _____ 30-34 _____ 35-39 _____

40-49 _____ 50-59 _____ 60 or over _____

8. To what (if any) national , state, or local educational organizations to you belong?

9. What professional educational publications (if any) do you read regularly?

10. What (if any) professional meetings sponsored by educational organizations have you attended in the last three years?

## QUESTIONNAIRE II

This questionnaire deals with opinions and attitudes about DMP and the inservice program. There are no right or wrong answers, so please be frank and honest in your replies. They will be of help in revising and improving DMP. Of course, your responses will be treated confidentially.

1. As a student my general attitude toward mathematics was:

| Highly Unfavorable | Moderately Unfavorable | Mildly Unfavorable | Mildly Favorable | Moderately Favorable | Highly Favorable |
|---|---|---|---|---|---|
| ___ | ___ | ___ | ___ | ___ | ___ |

2. My general attitude toward teaching mathematics prior to this year was:

| Highly Unfavorable | Moderately Unfavorable | Mildly Unfavorable | Mildly Favorable | Moderately Favorable | Highly Favorable |
|---|---|---|---|---|---|
| ___ | ___ | ___ | ___ | ___ | ___ |

3. As a teacher of DMP, my general attitude toward teaching mathematics is:

| Highly Unfavorable | Moderately Unfavorable | Mildly Unfavorable | Mildly Favorable | Moderately Favorable | Highly Favorable |
|---|---|---|---|---|---|
| ___ | ___ | ___ | ___ | ___ | ___ |

4. If your attitude toward teaching mathematics has changed, please explain what you believe caused the change.

5. a) Did you teach mathematics last year?

   b) If yes, what program or test did you use?

6. a) Do you teach mathematics differently this year because of DMP?

b) If yes, please describe the differences. You may wish to refer to objectives, assessment materials, manipulative materials, small group work, planning time, or other factors that are related to DMP.

7. What do you like most about DMP? Why?

8. What do you like least about DMP? Why?

9. a) Overall, do you like or dislike DMP?

b) Is it better or worse than programs or texts you have used in the past?

c) In what ways?

10. a) If you attended a DMP summer workshop, was it useful or a waste of time?

    b) If it was useful, was it adequate or inadequate?

    c) How could it be improved?

11. Give your evaluation of the group meetings with Ron Lange, Wayne Neuburger, and (for Chicago teachers) Bernadette Perham.

12.* Give your evaluation of the individual conferences with Bernadette Perham.

*Chicago teachers only.

13. a) Were you involved in making the decision to use DMP this year?

b) If yes, how?

c) If no, explain how you think the decision was made.

14. a. To what extent do you support the use of DMP in your school?

Fully (3) Moderately (2) Slightly (1) Not at all (0)

b. To what extent do you feel that your building principal supports the use of DMP in your school?

Fully (3) Moderately (2) Slightly (1) Not at all (0)

c. To what extent do you feel that the administration of your school system supports the use of DMP in your school?

Fully (3) Moderately (2) Slightly (1) Not at all (0)

d. What assistance have you received from your school system or from your principal that was particularly important in helping you use DMP?

e. What assistance have you failed to receive that would have helped you in using DMP?

## APPENDIX C

## OBSERVATION SCHEDULE

I. General

I.1. Identify the school (G-E, LL, MM, 4, V, C-H, C-P, C-W), the observer (by initials), the teacher (by code number), and the date of the observation.

I.2. Give the label of the activity observed; if the activity is not taken from the Teacher's Guide, describe it briefly. If the teacher is in charge of students who are working on more than one activity, describe each of the activities. (Use labels, if possible.)

I.3. Find out from the teacher the activity done just previous to the one observed.

I.4. Find out from the teacher the activity that she plans to do next. If she has not decided which activity to do next, write "ND" and state any reasons that she may offer for not deciding until later.

II. Materials

II.1. Identify the DMP printed materials used.

II.2. Identify the manipulative materials used.

II.3. Identify other materials (e.g., crayons or graph paper) that are used in the activity and important to the success of the activity when these materials have been provided by the teacher.

III. Structuring Comments--Opening and Closing Activities

III.1. If the observation includes the opening of the activity (or a part of an activity), mark O; for the middle or closing of an activity, mark M or C, respectively.

III.2. F. Focus--The teacher identifies the problem and/or the objective of the activity (during the opening or the closing, usually). Yes No

III.3. R. Relationship--The teacher states the relationship of this activity to previous work. Yes No

III.4. *C. Clarity--The teacher explains or summarizes the activity clearly and in a well-organized manner, presenting ideas at a cognitive level appropriate for her students. Yes No

III.5. SW. Students Working--State the ratio of the number of students working profitably on the activity to the number of students not working or confused. 0 - less than 25%, 1 - 25% up to 50%; 2 - 50% up to 75%; 3 - 75% or more.

III.6. D. Displays--The teacher displays and discusses student work at the close of the activity as she works for cognitive closure. Yes No

IV. Structuring the Classroom (during the middle or main part of the activity)

IV.1. G. Grouping--The teacher organizes the students to work on the activity individually, in pairs, in small groups of 3 to 10, or in large groups of 11 or more (Mark 1, 2, 3, or 4, respectively.)

IV.2. TM. Teacher Movement--The teacher moves from group to group (or individual to individual) in order to act as a resource person for the students. Yes No

*High-inference

IV.3. SM. Student Movement--Students move purposefully about the room to obtain materials, to consult with others, or for other task-oriented reasons. Yes No

IV.4. I. Student-Student Interaction--Students interact verbally while working on the activity. Yes No

IV.5. RO. Room Arrangement--The teacher arranges furnishings and materials in the room in a way that is appropriate for the activity. (For example, this behavior is demonstrated when the teacher puts several desks together to form a work area for a small group, following suggestions from the description of the activity.) Yes No

IV.6. *A. Assessment--The teacher assesses a student on the objectives of the activity by observation, i.e., the teacher observes a student apparently for purposes of assessment, whether or not the assessment is recorded. Yes No

IV.7. RA. Records Assessment--The teacher records her observations of student achievement in the pupil performance records. Yes No

IV.8. RD. Re-Directs--The teacher re-directs students when they finish an activity. Yes No

V. Verbal Behavior of the Teacher

V.1. U. Use of student ideas--The teacher uses student ideas by repeating them, modifying them, applying them, comparing them to other ideas, or by summarizing them. Yes No

*High-inference

V.2. P. Probing--The teacher probes a student response--i.e., the teacher asks a student or a group of students to justify or clarify a statement or to validate a mathematical statement. Yes No

V.3. C. Criticism--The teacher criticizes a student's contribution to a group discussion or to other group work. Yes No

V.4. *A. Authority--The teacher acts primarily as a mathematical authority figure rather than asking students to validate or justify their answers. Yes No

V.5. Q. The teacher asks questions about mathematical ideas related to the activity. Yes No

V.6. *L. The teacher uses lecture methods primarily rather than inquiry techniques when discussing mathematical ideas related to the activity. Yes No

*High-inference

**National Evaluation Committee**

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Immediate Past President
National Education Association

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Institute for the Study of Intellectual Behavior
University of Colorado

Jeanne S. Chall
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H. Craig Sipe
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State University of New York

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Northwestern University

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R & D Center

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University of Wisconsin

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Dan Woolpert
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R & D Center

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**Faculty of Principal Investigators**

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